Selecting Diodes

The diode is a critical component to all power supplies, as we have seen in class and in lab. The configuration of diodes for a rectifier we choose directly affects most other parts of our power supply design. However, the selection of diodes is actually relatively simple, and depends only on a handful of parameters:

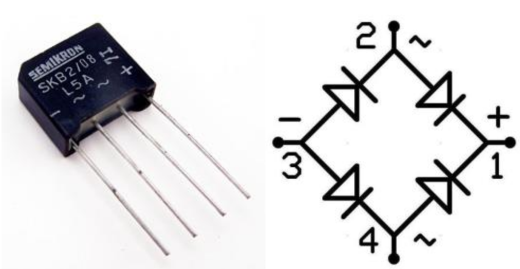
1. **Maximum Current** – Diodes typically are rated for maximum current in two ways. The first is the **average** forward current. We will use this figure to select our diodes in this assignment, based on the highest load current we expect to see in the circuit. The second is a **peak** forward current, which is usually rated only for a **short duration**. Sometimes there is a repetitive and non-repetitive peak rating. These relate to the peaks in current that occur when the power supply is first turned on and the capacitor charges from zero volts (non-repetitive), or when the capacitor charges from cycle to cycle (repetitive).
2. **Peak Inverse/Reverse Voltage (PIV/PRV)** – We already know how to calculate this from our diode examples in class; we will select diodes with some safety margin in this value, in case the rectified voltage fluctuates slightly.

We do not need to select directly by power dissipation, as we inherently do so when selecting by average forward current. One last point to note is that once we pick a diode, we can make an accurate estimation of the forward voltage from the datasheet. Other parameters mentioned in the lab, such as reverse recovery, etc. are not relevant for this problem, as we are dealing with low-frequency ($f < 1\ KHz$) rectification only.

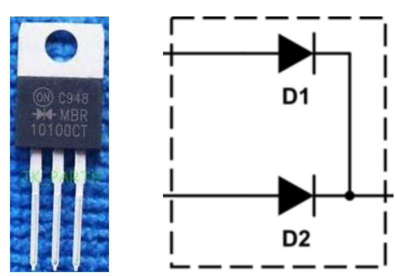
As before, we will continue an example from the class notes to explain the selection process. Recall again the full-wave example on p. 165 of the notes. The relevant information is copied below:

Desired Diode Specifications
Two Diodes, Positive Full-Wave Configuration
$PIV = 25\ V$
$I_{LOAD_{MAX}} = 1\ A$

One should note that the number of diodes and configuration is important. We can find individual diodes for most parameter sets, and any configuration (half-wave, full-wave, bridge) can be made from multiple separate diodes. However, there are also single-package diode sets which contain multiple diodes in a pre-made configuration.



Bridge Rectifier



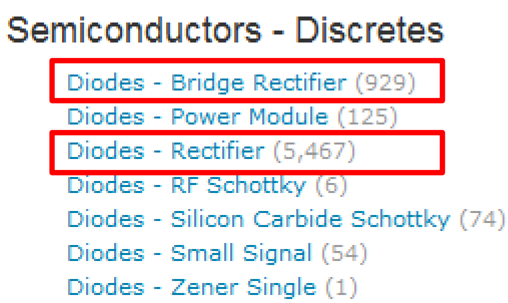
Full-wave Rectifier

These pre-packaged rectifiers should be used when electrically possible, as they typically are cheaper **and** smaller than sets of individual diodes.

Lastly, you may have noticed that the diode PIV was calculated earlier using a constant voltage model, with an arbitrary v_{D_0}. Typically, this will not be an issue, as we will select a diode with a significant safety margin on PIV when possible, so even if v_{D_0} changes slightly, PIV will still be within acceptable ranges.

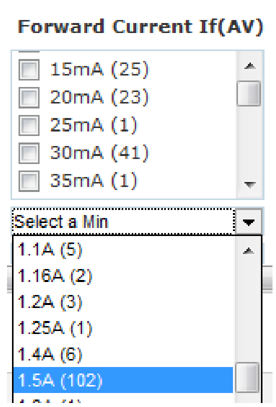
Selection Process

1. Again using your selected distributor or manufacturer (Newark for this example), search for rectifiers. Selecting the appropriate configuration yields a filterable list as before.

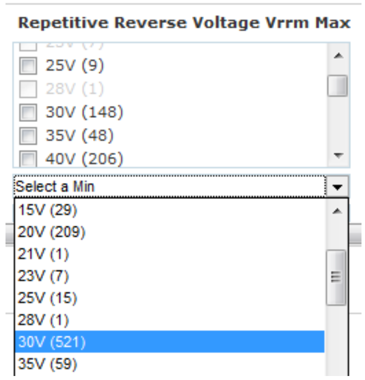


Select the ‘bridge rectifier’ category if you specifically want the 4-diode bridge configuration. Otherwise, select the rectifier category. Since this example is a full-wave, 2-diode type, we select this second category.

2. We next filter by forward (load) current, which was determined in the example to be at most $1\ A$. Note that I have selected a minimum of $1.5\ A$ to allow a **safety margin** in this parameter; it is unlikely to significantly increase the cost, but could be reduced if desired.



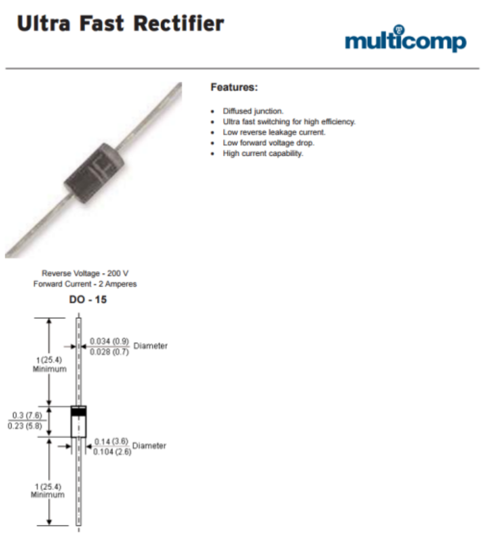
3. Next, we select by PIV (also called reverse voltage). Again, a safety margin is included:

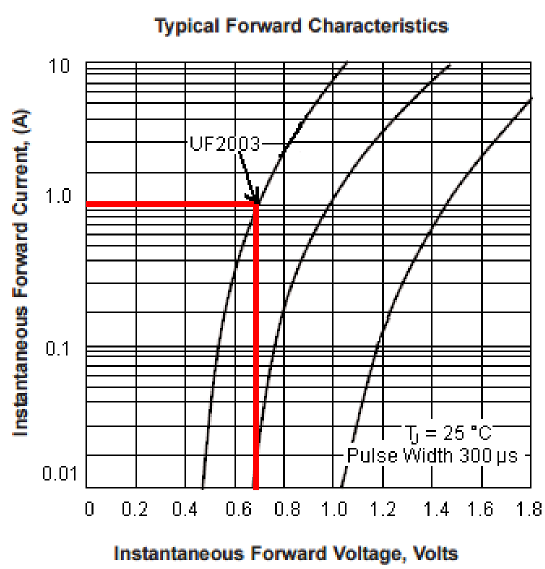


4. Lastly, we can sort by our secondary parameters (size, cost, etc.). If this were a real-world design, we would also filter by mounting type (surface mount vs. through-hole, see capacitor selection), but it can be ignored for this example. Selecting (by cost) the first rectifier that is actually in stock:

	Newark Part No.	Manufacturer Part No	Manufacturer / Description	Avail	Price	Qty	Diode Type	Diode Configuration	Repetitive Reverse Voltage Vrrm Max	Forward Current If(AV)	Forward Voltage VF Max	Reverse Recovery Time trr Max	Forward Surge Current Ifsm Max	Operating Temperature Max	Diode Case Style
☑	13T8711 Yes	UF2003	**MULTICOMP** **FAST RECOVERY DIODE, 2A, 200V, DO-15, FULL REEL** Write a Review | Ask a Question	6,000	**Price for:** Tape & Reel Full 1 3000+**$0.031** 6000+**$0.028** 9000+**$0.022** 15000+**$0.019** More Pricing	3000 Buy	Fast Recovery	Single	200V	2A	1V	50ns	60A	125°C	DO-15

The result is that we can use **two** of the above single diodes to build our full-wave rectifier. Notice that even though this is the cheapest result, it gives us an even larger than expected safety margin on PIV and forward current. The average forward voltage is also identical to that used in our earlier calculations ($1.0\ V$). If this value were not given, it can be found from the datasheet for this part as well:





Notice that the graph from the datasheet is actually more accurate. The $1.0\ V$ forward voltage is actually for the diode at **rated** current (i.e., $2.0\ A$ in this case). For our supply's maximum load current of $1.0\ A$, the diode voltage will actually be lower – around $0.7\ V$, actually. Selection is now complete.